PATENT APPLICATION
Docket No. 15436.441.4

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of		)
	Jae-Hyun Ryou	)
Serial No.:	10/611,992	) Art Unit 2828
Filed:	July 3, 2003	)
For:	PSEUDOMORPHIC LAYER IN TUNNEL JUNCTION VCSEL	)
Confirmation No.:	3405	)
Customer No.:	022913	)
Examiner:	Armando Rodriguez	)

AMENDMENT UNDER 37 C.F.R. § 1.111

Mail Stop AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office action mailed December 21, 2005 (the "Office Action"), please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

AMENDMENTS TO THE CLAIMS

The listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. **(Currently amended)** A vertical cavity surface emitting laser, comprising:

an indium-based semiconductor alloy substrate;

a first mirror stack over the substrate;

an active region having a plurality of quantum wells over the first mirror stack;

a tunnel junction over the active region, the tunnel junction having an n-side including an n-doped layer, and a p-side including a p-doped pseudomorphically strained layer of a compound selected from the group consisting of A1-rich InAlAs, AlAs, Ga-rich InGaAs, GaAs and combinations thereof, wherein the p-doped layer has an in-plane tensile strain so as to increase a carrier mobility in the tunnel junction and a hydrostatic strain so as to reduce a bandgap of the p-side layer; and

a second mirror stack over the tunnel junction.

2. **(Currently amended)** A vertical cavity surface emitting laser according to claim 1, wherein the p-side of the tunnel junction further includes a lattice matched Zn doped layer.

3. **(Original)** A vertical cavity surface emitting laser according to claim 1, further including an n-type spacer adjacent the active region, and wherein the first mirror stack is an n-type DBR.

4. **(Original)** A vertical cavity surface emitting laser according to claim 1, further including an n-type spacer adjacent the tunnel junction, and wherein the second mirror stack is an n- type DBR.

5. **(Original)** A vertical cavity surface emitting laser according to claim 1, further including:

an n-type bottom spacer adjacent the active region, and wherein the first mirror stack is an n-type DBR; and

an p-type top spacer adjacent the tunnel junction,

wherein the first and second mirror stacks are each an n-type DBR.

6. **(Original)** A vertical cavity surface emitting laser according to claim 1, wherein the p-doped pseudomorphically strained layer is grown by MOCVD or MBE.

7. **(Original)** A vertical cavity surface emitting laser according to claim 6, wherein the p-doped pseudomorphically strained layer is doped with carbon with a concentration greater than $1 \times 10^{19}\ cm^{-3}$.

8. **(Original)** A vertical cavity surface emitting laser according to claim 1, wherein the active region includes one of InGaAsP and AlInGaAs.

9. **(Original)** A vertical cavity surface emitting laser according to claim 1, wherein the tunnel junction further includes an n-doped layer of a compound in the group consisting of InP, AlInAs, AlInGaAs, or InGaAsP.

10. **(Original)** A vertical cavity surface emitting laser according to claim 1, wherein the first and second mirror stacks are lower and upper mirror stacks, respectively.

11. **(Currently amended)** A tunnel junction having a p-doped pseudomorphically strained layer, wherein the p-doped pseudomorphically strained layer includes a compound in the group consisting of A1-rich InA1As, A1As, Ga-rich InGaAs, GaAs and combinations thereof and, wherein the p-doped strained layer has an in-plane tensile strain so as to increase a carrier mobility in the tunnel junction and a hydrostatic strain so as to reduce a bandgap of a p-side layer of the tunnel junction.

12. **(Currently amended)** A tunnel junction according to claim 11, further including a lattice matched Zn doped layer.

13. **(Original)** A tunnel junction according to claim 11, wherein the p-doped pseudomorphically strained layer is doped with carbon with a concentration greater than $1x10^{19}$ cm^{-3}.

14. **(Original)** A tunnel junction according to claim 11, further including an n-doped layer of a compound in the group consisting of InP, AlInAs, A1InGaAs, and InGaAsP.

15. **(Original)** A tunnel junction according to claim 14, wherein the n-doped layer is doped with a concentration greater than $5x10^{19}$ cm^{-3}.

16. **(Original)** A tunnel junction according to claim 14, wherein the n-doped layer is less than about 10 nanometers thick.

17. **(Original)** A tunnel junction according to claim 14, wherein the n-doped layer is doped with a concentration greater than $5x10^{19}$ cm^{-3} and the n-doped layer is less than about 10 nanometers thick.

REMARKS

The present Amendment is in response to the Examiner's Office Action mailed December 21, 2005. Claims 1, 2, 11 and 12 are amended. Claims 1-17 are now pending in view of the above amendments.

Reconsideration of the application is respectfully requested in view of the above amendments to the claims and the following remarks. For the Examiner's convenience and reference, Applicant's remarks are presented in the order in which the corresponding issues were raised in the Office Action.

Please note that the following remarks are not intended to be an exhaustive enumeration of the distinctions between any cited references and the claimed invention. Rather, the distinctions identified and discussed below are presented solely by way of example to illustrate some of the differences between the claimed invention and the cited references. In addition, Applicants request that the Examiner carefully review any references discussed below to ensure that Applicants understanding and discussion of the references, if any, is consistent with the Examiner's understanding.

I. PRIOR ART REJECTIONS

A. Rejections Under 35 U.S.C. §102

The Examiner rejects claims 1, 6, 7, 10, 11 and 13 under 35 U.S.C. § 102(e) as being anticipated by *Chang et al.* (United States Patent No. 6,765,238), and claims 11-14 and 16 in view of *Sekiguchi et al.* (Jpn. J. Appl. Phys.). Applicant respectfully notes that a claim is anticipated under 35 U.S.C. § 102(a), (b), or (e) only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. Further, the identical invention must be shown in as complete detail as is contained in the claim. Finally, the elements must be arranged as required by the claim. Manual of Patent Examining Procedure ("MPEP") § 2131. Because neither *Chang* nor *Sekiguchi* teaches or suggests each and every element of the rejected claims, Applicants respectfully traverse these rejections in view of the following remarks.

In particular, independent claims 1 and 11 specifically require that the inventive tunnel junction include a "p-doped pseudomorphically **strained layer**" Moreover, the claims specify that the p-doped layer have an "in-plane tensile strain so as to increase a carrier mobility in the tunnel junction and a hydrostatic strain so as to reduce a bandgap of the p-side layer." As is

provided for in the specification, this claimed feature provides a tunnel junction that "has significant advantages over prior art long wavelength InP VCSELs." Page 10, paragraph 30.

Neither of the cited references teaches nor suggests the notion of providing a tunnel junction having a strained layer for achieving the claimed functional advantages. At best, *Chang* merely acknowledges that a n-type tunnel junction layer or a p-type tunnel junction layer "can be grown lattice-matched or pseudomorphically or otherwise applied." (column 17, lines 40-44). Nowhere does the reference teach a "strained layer" configured so as to increase carrier mobility and reduce bandgap. Similarly, *Sekiguchi* makes no mention of providing such a pseudomorphically strained layer in the tunnel junction. Since *Chang* and *Sekiguchi* do not teach the device being claimed in this application, Applicants respectfully request that the rejection of independent claims 1 and 11 under 35 U.S.C. § 102 be withdrawn. Moreover, for at least the same reasons, each of the claims depending from independent claims 1 and 11 – including rejected dependent claims 6, 10, 12-14 and 16 - are also patentably distinct and should be allowed.

In addition to its allowability based on its dependence from an allowable claim, in regards to dependent claim 12, nowhere does the *Sekiguichi* reference teach or suggest the concept of a "lattice-matched Zn doped layer" as a part of the p-side of the tunnel junction. In fact, *Sekiguichi* merely teaches the use of a Zn-doped InGaAsP layer to provide an "ohmic contact with the metals." (2^{nd} paragraph, page 443). Nowhere is it suggested that the Z-doped layer be "lattice-matched" as part of the p-side of the tunnel junction as is claimed.

B. <u>Rejection Under 35 U.S.C. § 103</u>

The Examiner rejects claims 2, 9, 15 and 17 under 35 U.S.C. § 103 as being unpatentable over *Chang* in view of *Sekiguchi*, and claims 3, 4, 5 and 8 under § 103 as being unpatentable over *Chang* and further in view of *Bour et al.* (US 2004/0161013). Applicant respectfully notes at the outset that in order to establish a prima facie case of obviousness, it is the burden of the Examiner to demonstrate that three criteria are met: first, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; second, there

must be a reasonable expectation of success; and third, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP § 2143.

As noted above in connection with both *Chang* and *Sekiguchi*, neither of those references teach or suggest at least one element of the independent claims 1 and 11. Nor does the *Bour* reference correct this deficiency. By virtue of their dependence from these independent claims, each of the rejected claims are patentably distinct and should be allowed over these references.

Moreover, insofar as neither of the references teach or even acknowledge the benefits derived from the claimed pseudomorphically strained layer in the tunnel junction, there would have been no suggestion or motivation to modify or otherwise combine the references in the manner urged by the examiner. Hence, the combination of the references in that regard is improper.

Again, in regards to claim to dependent claim 2, nowhere does the *Sekiguichi* reference teach or suggest the concept of a "lattice-matched Zn doped layer" as a part of the p-side of the tunnel junction. In fact, *Sekiguichi* merely teaches the use of a Zn-doped InGaAsP layer to provide an "ohmic contact with the metals." (2nd paragraph, page 443). Nowhere is it suggested that the Z-doped layer be "lattice-matched" as part of the p-side of the tunnel junction as is claimed.

CONCLUSION

In view of the foregoing, Applicants believe the claims as amended are in allowable form. In the event that the Examiner finds remaining impediment to a prompt allowance of this application that may be clarified through a telephone interview, or which may be overcome by an Examiner's Amendment, the Examiner is requested to contact the undersigned attorney.

Dated this 21st day of June, 2006.

Respectfully submitted,

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